JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1996, 29, 53–66 NUMBER 1 (SPRING 1996)

PEER MODELING OF RESPONSE CHAINS: OBSERVATIONAL LEARNING BY STUDENTS WITH DISABILITIES

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Peer models (classmates without disabilities) who were proficient in performing a task completed one response chain each day and described the steps they performed while their classmates with disabilities observed. Three students with disabilities participated, and their performance of the response chains was assessed immediately prior to and following the peer modeling each day. A multiple probe design across response chains, replicated across children with disabilities, was used. In addition, participation and social interactions of children with disabilities and their peer models were assessed in classroom activities after daily modeling sessions. The results indicate that the peer models performed the response chains accurately and quickly, and students with disabilities acquired the response chains. Across the study, participation in classroom activities was high, social interactions were low, and neither was affected by the peer modeling intervention.

DESCRIPTORS: modeling, peer modeling, response chains, children with disabilities, observational learning

The potential for observational learning and the development of positive social relationships are major rationales for inclusive schooling—the enrollment of children with disabilities in the general education classrooms they would have attended if they did not have disabilities (Stainback & Stainback, 1992). Several studies have focused on the effects of peer models. Goldstein and Mousetis (1989) demonstrated that students with mental retardation acquired and generalized expressive language when their peers with disabilities modeled the responses in highly controlled situations. Egel, Richman, and Koegel (1981), working with students with autism, demonstrated that the students observed models and imitated discrete responses. Other studies have documented that students with disabilities often acquire some but not all of the behaviors taught to their peers with disabilities during small-group instruction. These studies have focused on discrete responses such as naming pictures, reading words, or answering questions (Alig-Cybriwsky, Wolery, & Gast, 1990; Doyle, Gast, Wolery, Ault, & Farmer, 1990; Farmer, Gast, Wolery, & Winterling, 1991; Keel & Gast, 1990; Wolery, Cybriwsky, Gast, & Boyle-Gast, 1991). In these studies, students were each taught different behaviors. The teacher cued all students to look at the instructional stimuli, provided a trial to 1 student, prompted that student's response, and reinforced correct responding. Many of the skills needed by students with substantial disabilities, however, are response

This study was supported by the U.S. Department of Education, Office of Special Education and Rehabilitative Services (Grant H086D20005). However, the opinions expressed do not necessarily reflect the policy of the U.S. Department of Education, and no official endorsement should be inferred. The authors are grateful for the assistance provided by Paula Calabrese, Assistant Superintendent; Richard Baker, Principal; Barbara Davis, Cathleen Zierenberg, and Carolyn Frederick; teachers at Hampton Township School District, and the parents who allowed their children to participate. The authors also acknowledge the contributions made by Erin Snyder, Leslie Anthony, Julie Katzenmeyer, and Christine Salisbury of the Child and Family Studies Program, Allegheny-Singer Research Institute.

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chains (i.e., a series of behaviors sequenced together to form a complex skill).

Research on teaching response chains directly has focused on how to structure instructional sessions. From this research, it appears that (a) use of single trials in a total-task arrangement (teaching all steps simultaneously) is superior to multiple trials in each instructional session with backward chaining (Kayser, Billingsley, & Neel, 1986), (b) total-task instruction is superior to forward chaining (McDonnell & McFarland, 1988), (c) total-task instruction can be effective with multiple (Schoen, Lentz, & Suppa, 1988) or single trials per session (Wolery, Ault, Gast, Doyle, & Griffen, 1990), and (d) instruction with a functional (noncritical steps being performed in any order) rather than a prescribed sequence of steps results in more rapid acquisition and fewer errors (Wright & Schuster, 1994). Further, chained tasks should be taught at naturally occurring opportunities (i.e., when the child needs to perform the task) (Colozzi & Pollow, 1984).

In addition, a few studies have focused on whether students with disabilities acquire response chains from opportunities to observe their peers. In these studies, students were placed in dyads or small groups (e.g., 3 students), and 1 student was taught the skill while the others observed the training session. The teacher cued the observers to watch the instruction and then provided task directions, prompts, and reinforcers to the student who was learning the response chain (i.e., the model). Sometimes, reinforcement was provided to the observers for watching, and observers were asked to praise the model. Models and observers acquired the chains when each student was taught some of the steps directly and observed other steps (Hall, Schuster, Wolery, Gast, & Doyle, 1992; Wolery, Ault, Gast, Doyle, & Griffen, 1991), when the model was taught the entire chain and 1 observer watched (Schoen et al., 1988; Schoen & Sivil, 1989), and when the model was taught the entire chain while 2 observers were present (Griffen, Wolery, & Schuster, 1992). All of these studies, however, occurred in special education contexts in which at least 1 student was taught the response chain directly by the teacher. Further, the peers observed reinforcement being provided for the student being taught (i.e., the model) for performing the response chains. Related research indicates that children without disabilities are more likely to imitate competent rather than less skilled models (Thomas, Due, & Wigger, 1987).

The primary purpose of this study was to determine whether students with disabilities enrolled in general education classrooms would learn response chains by observation when those chains were modeled by a classmate who accurately completed the task and described the steps while completing them in a realistic situation. Verbal description by the model was used because some research indicates that such behavior increases the probability of imitation (Hay, Murray, Cecire, & Nash, 1985). Acquisition of the response chain and generalization across materials were evaluated. A secondary purpose of the study focused on students' social interactions and participation in activities immediately following daily peer modeling sessions, because previous research on direct teaching and observational learning of response chains had occurred in special education contexts without monitoring social interactions or participation in subsequent activities. Much of the rationale behind inclusive education for students with disabilities lies in the social benefits available when they are educated with students without disabilities (Hundert & Houghton, 1992). Putnam (1993) states that learning is a social act and that inclusive class settings allow students to model appropriate behaviors. An instructional arrangement that requires 1 stu-

dent to model a task and describe to another how to complete a chain of behaviors necessitates that 2 students be in close physical proximity. This contact may increase the probability of social exchanges and the development of friendships. There is no research available, however, on the effects of such an instructional arrangement on social interactions.

METHOD

Participants and Setting

Fifteen students from an elementary school in a suburban school district were selected for this study. Three students (Charlie, James, and Eleanor) had disabilities, and the remaining 12 were peer models who had no diagnosed disabilities. The peer models were students in the same general education classrooms as the students with disabilities. They were selected by the classroom teachers based upon a history without negative interactions with their classmates with disabilities and the availability of guardian permission. Multiple peer models were selected for each child with disabilities to reduce the demands placed on any one model.

The 3 students with disabilities were enrolled in general education classrooms for at least part of the school day. All were verbal and demonstrated the following skills prior to the study: (a) auditory acuity and compliance with simple requests, (b) visual acuity adequate to see the materials and the behaviors modeled in the chains, (c) motor control required to perform the assigned chains, and (d) motor imitation of simple peer behaviors on request. All were Caucasian (one of Hispanic origin) from two-parent homes in the middle to upper-middle income range.

Charlie was 7 years 6 months old and was enrolled in a first grade classroom for 48% of his school day. He was diagnosed as developmentally delayed with Opitz-Frias syndrome, an autosomal dominant trait characterized by asymmetrical skull, hypertelorism, slit-like eyelids, epicanthus, and mental retardation. Charlie had been in inclusive classrooms for 3 years in elementary school and for 2 years in an integrated preschool. He scored a full-scale IQ of 53 on the Stanford-Binet Intelligence Test Form L-M (Terman & Merrill, 1973) with a relative strength in verbal identification and a weakness in motor skills. On the Peabody Picture Vocabulary Test—Revised (PPVT–R) (Dunn & Dunn, 1981), he received a standard score of 62, indicating a severe deficit. On the Test of Language Development—2 (TOLD–2) (Newcomer & Hammill, 1988), he scored in the 5th percentile. Peer models for Charlie were Janet, Patrick, Andy, and Dave.

James was 8 years old and had been diagnosed as developmentally delayed with autistic behaviors. He had attended inclusive elementary classrooms for 3 years and was attending the first grade classroom approximately 57% of his school day. On the Stanford-Binet Intelligence Test—IV (Thorndike, Hagen, & Sattler, 1986), he received a composite score of 63, with relative strengths in short-term memory and reasoning and a relative weakness in comprehension. On the TOLD–2, his scores were in the 1st percentile. A PPVT–R given at the age of 7 yielded an age equivalency of 5 years 1 month, which is below the 1st percentile for his chronological age. Peer models for James were Gretchen, Frederick, Elliot, and Harold.

Eleanor was 7 years 8 months old, was fully included in a half-day afternoon kindergarten class, and attended a special education class for the remainder of the day. She was diagnosed as developmentally delayed secondary to complex chromosomal abnormalities, which included an inversion of the 13th chromosome. Eleanor had attended a developmental program for children with

brain injury for 6 years prior to entering public school. She was given the Stanford-Binet Intelligence Test Form L-M (Terman & Merrill, 1973) at the age of 5 years, and scored a full-scale IQ of 34. On the PPVT–R, she received a standard score of 48, indicating a severe deficit. On the Preschool Language Scale (Zimmerman, Steiner, & Evatt, 1969) given at a chronological age of 5 years 1 month, she scored a language age of 2 years 9 months, an auditory comprehension age of 3 years, and a verbal age of 2 years 6 months. Peer models for Eleanor were Ashley, Sarah, Leslie, and Imelda.

All instructional and probe sessions were conducted in three elementary school classrooms (one kindergarten and two first grade classes). Sessions for Charlie occurred at his desk and on the floor, or he moved to the computer at the front of the classroom. Sessions for James occurred at his desk, and for Eleanor either on the floor in a front corner of the classroom or at a round table at the rear of the classroom.

Tasks and Materials

Three chained tasks were chosen for each child in consultation with the classroom teachers. Tasks were judged to be functional or useful to the child, but were not being taught or scheduled to be taught. Five tasks were selected for the 3 children with disabilities. The tasks for James were spelling his last name using letter tiles, playing an audiotape, and using a calculator to perform a simple addition problem. The tasks for Eleanor were playing an audiotape, sharpening a pencil, and sequencing number tiles. The tasks for Charlie were using a computer program, using a calculator to add 2 + 3, and sharpening a pencil.

An audiocassette player equipped with a y-jack connecting two sets of earphones and a tape cued to 3-s intervals were used during observations. A stopwatch was used to time the length of the modeling and probe sessions. For James, assorted stickers were used as reinforcers.

Procedures

Experimental design. A multiple probe design across response chains, replicated across students, was used to evaluate the effect of peer modeling. Initially, students with disabilities were screened to identify response chains they did not perform. Each student with disabilities was assigned three chains, at least one of which was also assigned to another student.

During the first probe condition, students with disabilities were assessed on each of their three response chains; the first two to be taught were assessed on three occasions, and the third was assessed twice. The investigator then taught the peer model to perform and describe each step of the first response chain that was to be modeled for his or her classmate with disabilities. The first instructional condition was then introduced. Each instructional day involved three segments: (a) The student with disabilities was probed on the response chain to be modeled, (b) the peer model was called to the instructional area and modeled the response chain while describing each step as it was performed, and (c) the student with disabilities was again probed on the response chain. Following completion of these three daily segments, an observer recorded the social interaction and participation of the student with disabilities and the model for 10 min in the classroom activity that immediately followed. When criterion level performance (i.e., 100% correct responding on 2 of 3 days in the first daily probe) was achieved by the student with disabilities, a probe condition was reinstated and the student with disabilities was assessed on all three chains (the first and second chains receiving three assessments and the third receiving two). The peer models were taught to perform and describe the steps of the second response

chain, and the modeling condition was introduced for that chain. This sequence of conditions was repeated until students with disabilities had acquired three response chains. Probes across similar but different materials were then conducted.

Proficiency of the models in implementing the modeling. The investigator taught the peer model to perform each response chain before allowing him or her to model the chain for the classmate with disabilities. These sessions occurred in small groups in the classroom. In the first training session, the investigator provided a rationale for the training ("to help friends learn how to do things you know how to do"). The investigator modeled the chain and gave scripted verbal descriptions of each step. The models were then asked to do the chain while the investigator described each step and praised them for correct performance. Then, the investigator observed while the models each performed and described the steps. Finally, the models role-played the chain with each other. Training continued until each model accurately described each step while performing it correctly. One to four training sessions (5 to 10 min in duration) were necessary to achieve accurate performance of the chain and to recite the scripts.

The peer models implemented the modeling procedures with high degrees of proficiency and consistency. Charlie's peer models' performance was 98.3% (range, 97.5% to 100%) for providing the verbal descriptions and 100% for the completion of steps. His models initiated 99.7% of the steps without a prompt from the investigator. James's peer models' performance was 100% for providing the descriptions and 99.6% (range, 99.3% to 100%) for the completion of steps. His models initiated 95.7% of the steps without a prompt. Eleanor's peer models' performance was 98.4% (range, 91.7% to 100%) for providing descriptions and 100% for the completion of steps. Her models initiated 98.0% of the steps without a prompt (range, 95.2% to 100%).

Probes. Before instruction and after criterion was met on each chain, students with disabilities were probed on the assigned chains. The investigator provided the materials and asked, "Ready to work?" After an affirmative answer, the investigator gave the task direction (e.g., "Play a tape"). The student was given 4 s to begin the first step of the chain. If the step was performed correctly, the investigator recorded the response but did not respond to the student. If it was not performed correctly, the investigator shielded the materials from the child's view, completed the step, and cued the child to implement the next step. This continued until the chain had been completed by the child or the investigator. Thus, the student's performance on each behavior of the chain was assessed. Upon completion of the chain, the investigator praised the student (i.e., "good work") and waited at least 30 s before beginning a probe trial on another chain. Probes occurred over 4 days, with two chains presented to the child each day. Two of the chains were assessed three times during each condition. The chain most removed (in time) from instruction was assessed twice.

Instructional conditions. Each session consisted of a probe trial, peer modeling, and an imitation probe trial. The daily probe trial was conducted in a manner identical to the procedure used in the full probe condition, except that only the response chain to be modeled was assessed.

After the probe trial, the investigator (or the student) asked a peer model to come to the training area. The model was positioned next to the student with disabilities so that the task materials were visible to both students. The investigator then asked the peer model, "Are you ready to work?" and delivered the task direction. The model performed the chain and described each step. The investigator observed and was available

to provide assistance to the model as necessary. When the chain was completed, the investigator praised and thanked the model. The model then returned to classroom activities.

The investigator began the second probe trial by asking the student with disabilities, "Are you ready to work?" The investigator delivered the task direction, and the student attempted the task again using the same procedures as in the first daily probe. When criterion was met, the full probe condition was reinstated.

Observation of levels of interactions between peers and participation in classroom activities. Levels of participation and interaction that occurred immediately after the intervention were measured daily. These measures were taken for both the student with disabilities and the models to check for shifts as a result of the peer modeling. Participation and social data were coded on alternating 3-s intervals for 10 min. The child with disabilities and the peer model for that day were observed in alternating 2.5-min blocks of intervals. Baseline observations were taken at the same times, during the same activities, and with the same children as the observations following modeling sessions. Although activities varied slightly across the school days, Charlie and his models were observed during structured opening exercises that involved the entire class. James and his models were observed during snack time, and students were encouraged to talk with one another as they finished their snacks. Eleanor and her models were observed during a period that involved a choice of individual or small-group activities.

During these observations, the child's participation was scored in two ways. *Appropriate behavior* was defined as active and appropriate attention to or interaction with the materials, activities, or persons, and appropriately waiting for teacher directions as well as an absence of inappropriate behavior. It was scored if observed for a whole interval. *Inappropriate behavior* was defined as disruptive behavior or the lack of attention to materials, activities, or persons. It was scored if observed for a partial interval.

Three categories of social behavior were recorded using an interval recording system. *No interaction* was defined as the child not interacting with any other child for the whole interval (interactions with teachers or teacher's assistants were allowed). *Interaction* was defined as the child being engaged in verbal or physical exchanges with another child (partial interval) and was recorded as either social or instructional. An *instructional interaction* was any exchange between peers, regardless of the initiator, that was academic in nature (including tutoring, asking for help, reading together, etc.). A *social interaction* was talking, touching, or sharing that was not academic or instructional.

Reliability and Procedural Fidelity

Interobserver agreement assessments for student responding were conducted on 28.3% of the daily probe trials, imitation probes, and full probes across all subjects. It was calculated using the point-by-point method for each step of each chain and was 100% in all cases.

Interobserver agreement was assessed in 31.3% of all sessions on the peer models' performance of initiating the chain without a prompt from the investigator, describing each step, and doing each step correctly. The point-by-point method was used to calculate the agreement percentages. The agreement percentages were 100% in all sessions with the following exceptions: Agreement on initiating the chain without a prompt was 97.7% for James's models and 98.7% for Eleanor's models, and agreement on the performance of steps was 98.8% for James's models.

Interobserver agreement on the observed level of participation in classroom activities

and social involvement was assessed in 43.7% of the observations. The point-by-point method was used to calculate the agreement percentages. The mean percentages of agreement were as follows: appropriate behavior, 99.3% (range, 98.6% to 100%); inappropriate behavior, 100%; social interactions, 82.7% (range, 77.1% to 90%); instructional interactions, 85.0% (range, 82.8% to 100%); and no interactions, 99.3% (range, 98.2% to 100%).

Procedural fidelity assessments were conducted simultaneously with student responding to assess the investigator's compliance with planned procedures. The behaviors assessed during probes included having the materials ready and asking if the student was ready to work, ensuring an affirmative response, providing the task direction, waiting for the appropriate response interval, and completing uninitiated or incorrectly executed steps in the chain outside of the view of the student. Fidelity was 100% in all cases.

RESULTS

Effectiveness of Peer Modeling

Percentages of correct responding on probes and imitation of peer models' behavior for Charlie, James, and Eleanor are shown in Figures 1, 2, and 3, respectively. The children did not perform all the steps of any of the chains correctly prior to peer modeling. Following demonstration and imitation, each of the students reached criterion-level responding on each of three response chains.

Each child was taught three tasks involving 7 to 10 steps in 5 to 29 daily sessions. The time involved for probing, modeling, and imitation varied across chains, but averaged 4 min 6 s per day. Because peer models were involved in approximately 25% of the sessions, their time averaged between 4 and 5 min per week. The class time used for the child with disabilities was longer. The child with disabilities was given two attempts each day and was allowed a response interval to complete each step. The peer models completed the task once each day and did not need the additional time because of earlier training. The class time used for James for probes for sequencing letters was 34 min 31 s (peer models, 25 min 36 s), for playing a tape was 15 min 8 s (peer models, 5 min 33 s), and the time needed for adding an equation on a calculator was 19 min 9 s (peer models, 7 min 5 s). The class time used for Eleanor for probes for playing an audiotape was 69 min 9 s (peer models, 21 min 51 s), for sharpening a pencil was 25 min 37 s (peer models, 6 min 23 s), and for sequencing numbers was 26 min 45 s (peer models, 4 min 34 s). The class time used for Charlie for using the computer program was 28 min 34 s (peer models, 14 min 21 s), for adding an equation on the calculator was 66 min 41 s (peer models, 17 min 32 s), and for probes for sharpening a pencil was 8 min 51 s (peer models, 3 min 27 s).

Some modifications of the tasks were required for students with disabilities to perform them successfully. In playing an audiotape, Eleanor experienced physical difficulty completing the step in which she was to slide the tape into the holders on the tape door. When she could perform all other steps in the chain, the models were instructed to show her how to tilt the recorder so that she could see the prongs on the door of the tape holder. In sequencing number tiles, she erred on the correct positioning of the stand. The models were instructed to place the stand on the table and then to slide an index finger along the grooved part of the stand where the tiles were placed. Following each modification, she performed the steps independently after two sessions.

In using the calculator to add a simple equation, neither James nor Charlie was

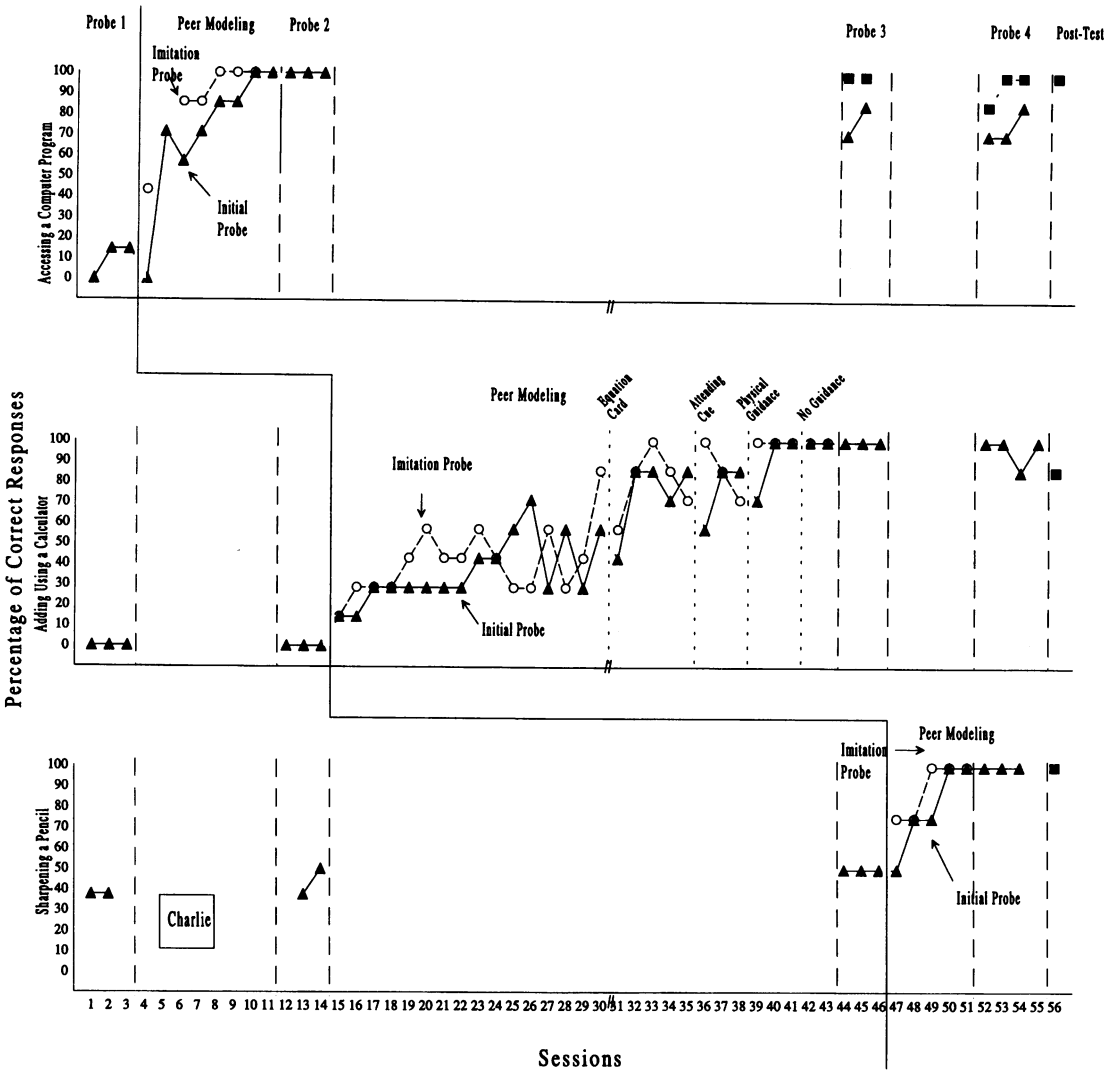

Figure 1. Percentage of steps performed correctly by Charlie for three response chains. Triangles represent percentage of steps correct in initial probes, and open circles represent percentage of steps correct in imitation probes.

consistent in the sequence of entering numbers and functions. The models were given a white card (30 cm by 15 cm) with "2 + 3 =" handwritten in black letters (6.5 cm), and they were instructed to show the card to the child while they performed the calculation. The visual cue was effective for James. Charlie continued to make errors, and his peer models were instructed first to point to a character on the equation card and then to press the corresponding button on the calculator. The investigator guided Charlie's hand if he pointed to numbers and functions out of sequence. The guidance was dropped for the final two sessions, and Charlie maintained 100% correct implementation of the task. The card with the written equation remained in place for the remainder of the trials.

In the observation sessions for the first chain, James initially refused to comply with the request to perform the chain in imitation

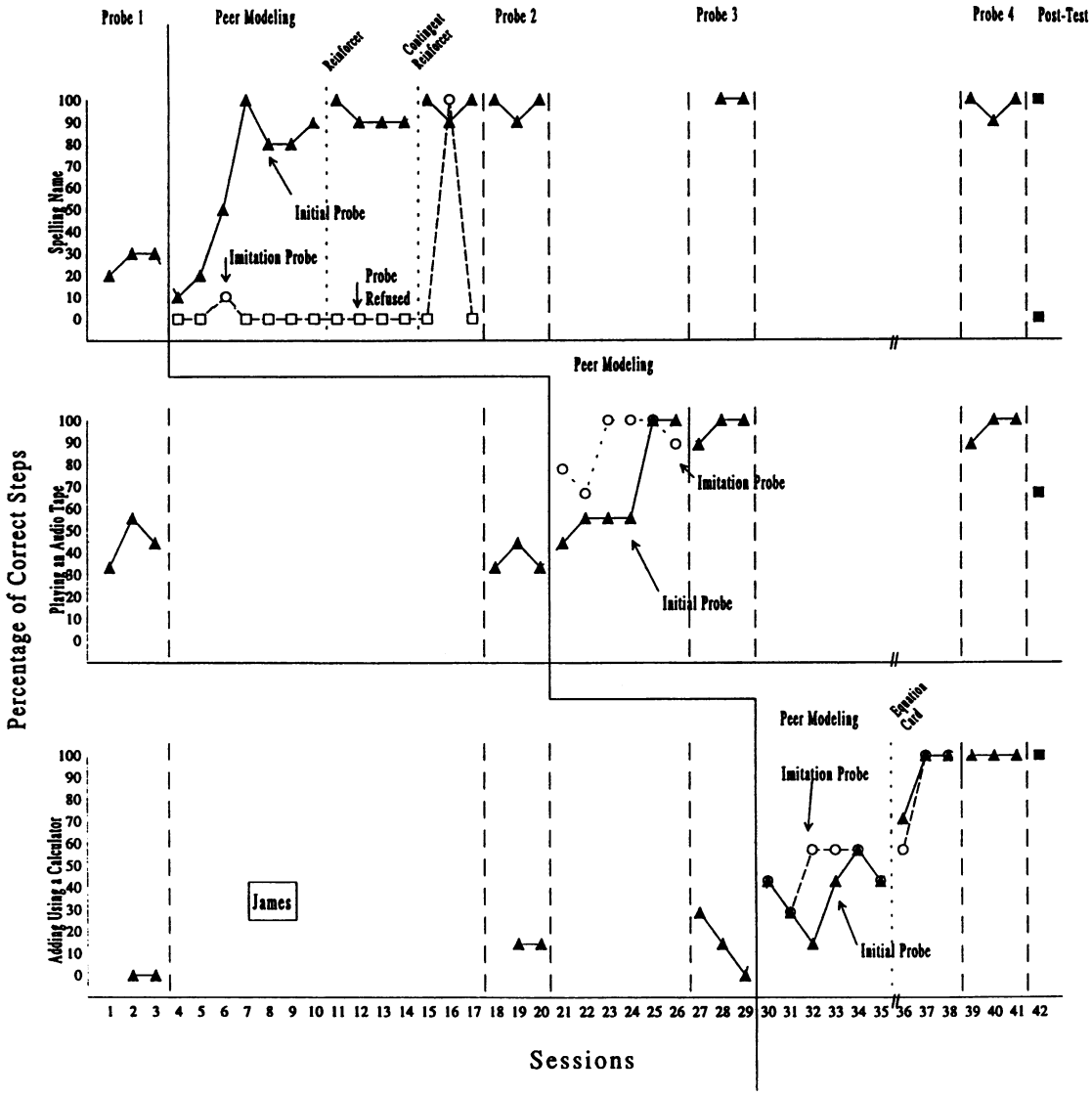

Figure 2. Percentage of steps performed correctly by James for three response chains. Triangles represent percentage of steps correct in initial probes, and open circles represent percentage of steps correct in imitation probes.

of the model. He achieved 100% correct performance on each of the steps in the initial probe in the fourth session, but then his performance dropped. He was offered a reinforcer (stickers) to comply with the investigator's requests. This resulted in James immediately performing the chain at 100%, but his performance again dropped off, and he still did not comply with the request to perform the chain a second time. He was then given a reinforcer contingent upon 100% correct implementation of either the first probe trial or the second imitation trial. A reinforcer, noncontingent upon performance but contingent upon compliance, remained in effect for the second and third chains.

Posttest Measures with Different Materials

A single posttest for extensions of skills across materials was conducted for each

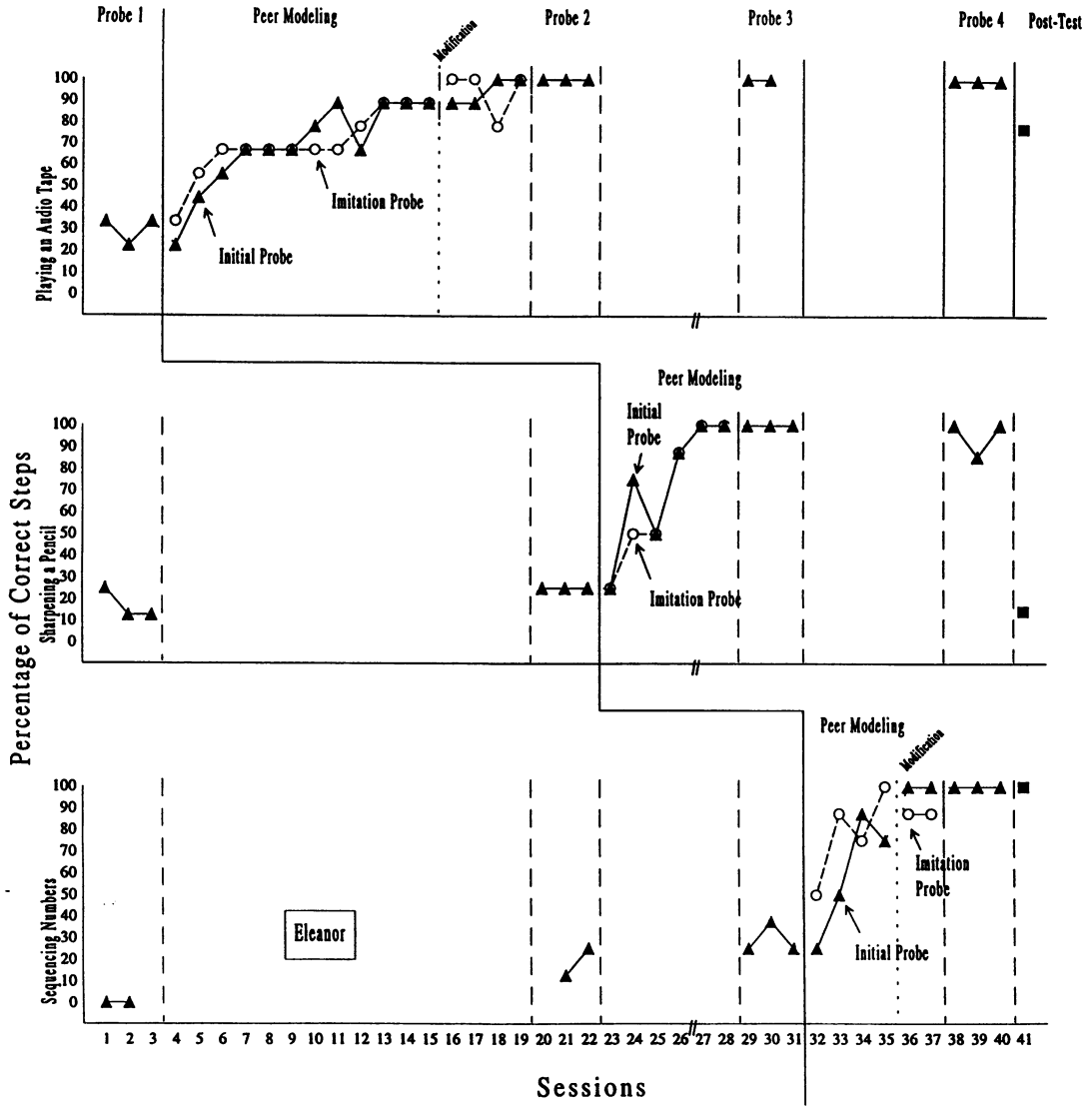

Figure 3. Percentage of steps performed correctly by Eleanor for three response chains. Triangles represent percentage of steps correct in initial probes, and open circles represent percentage of steps correct in imitation probes.

chain after the final probe condition. Percentage of correct performance is shown in Figures 1 through 3. Charlie was asked to retrieve a different computer program, and he performed 100% of the steps correctly; however, he modified the steps of the demonstrated procedure and used the button on the mouse instead of the return key to select an icon. Using the key on the mouse was one of the steps taught at another point on the chain. James and Charlie were given an equation card and asked to add 4 + 1 on the calculator. James performed 100% of the steps correctly, and Charlie performed 85.7% of the steps correctly. Charlie and Eleanor were asked to sharpen a pencil on an electric sharpener. Charlie performed 100% of the steps correctly. Eleanor did not complete the task (performing only 14.2% of the steps). She would not operate a

"noisy" machine, but she verbalized the steps needed to perform the task. James and Eleanor were asked to play a tape on a portable recorder; James performed 66.7% of the steps correctly, and Eleanor performed 77.8% of the steps correctly. Both children asked for help identifying the unmarked keys. James verbally spelled his last name and Eleanor counted from 1 to 4.

Levels of Participation and Interaction During Classroom Activities

Observations of participation and interaction were brief and occurred immediately after the peer modeling and imitation probe sessions. The percentage of intervals in which the children with disabilities and their models participated in classroom activities was consistently high in both baseline and modeling phases and did not vary across the study. The percentages for appropriate behavior for each child, with each model, and on each chain were 100%.

Despite opportunities to interact, relatively little social behavior was observed across conditions, and no shifts in the levels of interaction were noted for the duration of the study. For children with disabilities, the mean percentage of intervals with social interaction across conditions was 4.9% (range, 0% to 11.7%); for their peers it was 8.4% (range, 0% to 15.5%).

Teachers' Evaluation of Social Validity

At the conclusion of the study, the three teachers who were including James, Eleanor, and Charlie in their general education classrooms were interviewed individually using a structured protocol. They were asked whether they would use the modeling procedure to teach similar goals to children in their classrooms. Each teacher said they would, but it was not observed. James's teacher commented that the children responded well to the repetition and consistency of the approach and that the step-by-step analysis of the task appeared to be helpful to him. Charlie's teacher stated that it was helpful because it did not require one-to-one teacher time with the child to instruct routine tasks. She noted that, following the conclusion of the study, when some of the children mastered tasks (such as putting puzzles together) they asked if they could show Charlie the steps. She said she thought it made Charlie be "a part of the class." All three teachers responded positively when asked if the time spent training the tutors and the time spent in modeling were beneficial.

DISCUSSION

The effects of using peer models to demonstrate multistep tasks in a total-task, one-trial-per-day format were evaluated. Peer models performed the chains and described the steps as they were completed with a high degree of accuracy, and 3 students with disabilities each acquired three chains containing at least seven steps. Modifications were made in the chains for each child. Except for one case, the modifications involved teaching the models a refinement of the procedures (addition of a visual cue and modifying the chain to make it physically easier). For Charlie, one modification (physical guidance) was implemented by an adult. The use of this prompt was minimal, and Charlie maintained correct performance of the step sequence when the physical guidance was faded. Participation in subsequent classroom activities was consistently high and social interactions were consistently low for all children; these measures were not affected by the peer modeling.

This study extends earlier research on observational learning of response chains by students with disabilities (Griffen et al., 1992; Hall et al., 1992; Schoen et al., 1988; Schoen & Sivil, 1989; Wolery, Ault, Gast, Doyle, & Griffen, 1991). It differed from previous studies in several ways: (a) Peer

models were proficient in the chains prior to modeling sessions; (b) peer models were not reinforced for doing individual steps of the chain, but they were praised or thanked at the end of the chain; (c) peer models performed the steps quickly; (d) peer models described steps as they were performed; (e) peer models were not disabled; (f) the peer model changed each day, with each model being used about every four sessions; and (g) the study occurred in general education classrooms rather than in special education contexts. Despite these differences, students with disabilities acquired each response chain.

Future research could address several issues. In this study, an adult but not the peer model observed the performance of the child with disabilities. The effects of this adult observation are not known. Under usual classroom conditions, teachers may observe only on an intermittent basis; thus, this should be evaluated. Likewise, having the peer model observe the child with disabilities perform the chain may affect learning and may provide the peer model with information for making modifications to the chain. In this study, peer models described the steps as they were completed. The effects of those descriptions are not known, but they may have functioned as a verbal mediator. James sometimes repeated the step descriptions during the probe sessions immediately after peer modeling. Eleanor repeated some of the verbal scripts as well, particularly the first step. Charlie's statements were different from those used by his peers. Also, the descriptions were standardized for each chain, making them consistent across models and days. Future research could evaluate having each peer model describe what he or she is doing in his or her own words rather than using a standard script. If effective, this modification would require less training of peer models, reducing their time commitment. Future research should also evaluate the effects of various reinforcement contingencies during peer modeling, such as having the peer model deliver reinforcers contingent upon correct performance.

The effects of the daily probe trials immediately before and after the peer's model are not known. Generally, the percentage of correct responses in the daily probe trial before the modeling was lower than the percentage of correct responses in the trial immediately after modeling. Active performance of the chain may have contributed to children's learning. The probe trial that occurred before the peer model each day was viewed as a more stringent estimate of the child's acquisition of the chain, and it was included for experimental rigor. However, the demands on teachers and children would be lessened if such probes were provided weekly or only after the child consistently completed the chain accurately in the probe immediately after peer modeling. Also, studies are needed to evaluate factors that influence generalization across novel response chains.

The level and trend of social interactions appeared to be unaffected by peer modeling. Several components of the procedure may have minimized the likelihood that it would influence social interactions. Each model participated for only a few minutes each week, interaction during peer modeling was not required, the model left the area before the child with disabilities attempted the chain, and the sessions were scripted. Changing the task structure may increase socialization. Potential changes include having the models watch the child with disabilities attempt the chain, adding social statements to the scripts, and using one rather than multiple peer models. More direct instructional methods, however, may be needed to increase social interactions between children with and without disabilities in inclusive settings (Odom, McConnell, & McEvoy, 1992).

The peer modeling procedure may hold advantages over one-to-one instruction of chained tasks. It may reduce the amount of teacher time and prompting required, allow students with disabilities access to more helpers, be easily embedded into ongoing classroom activities, and lead to more generalized observational learning. Given the findings of the study, we recommend use of the peer modeling procedures. Such use, however, should be implemented systematically, peer models should describe the steps as they perform them, and the performance of the students with disabilities should be assessed regularly.

REFERENCES

Alig-Cybriwsky, C. A., Wolery, M., & Gast, D. L. (1990). Use of a constant time delay procedure in teaching preschoolers in a group format. *Journal of Early Intervention, 14,* 99–116.

Colozzi, G. A., & Pollow, R. S. (1984). Teaching independent walking to mentally retarded children in a public school. *Education and Training of the Mentally Retarded, 19,* 97–101.

Doyle, P. M., Gast, D. L., Wolery, M., Ault, M. J., & Farmer, J. A. (1990). Use of constant time delay in small group instruction: A study of observational and incidental learning. *Journal of Special Education, 23,* 369–385.

Dunn, L. J., & Dunn, L. M. (1981). *Peabody Picture Vocabulary Test—Revised.* Circle Pines, MN: American Guidance.

Egel, A. L., Richman, G., & Koegel, R. L. (1981). Normal peer models and autistic children's learning. *Journal of Applied Behavior Analysis, 14,* 3–12.

Farmer, J. A., Gast, D. L., Wolery, M., & Winterling, V. (1991). Small group instruction for students with severe handicaps: A study of observational learning. *Education and Training in Mental Retardation, 26,* 190–201.

Goldstein, H., & Mousetis, L. (1989). Generalized language learning by children with severe mental retardation: Effects of peers' expressive modeling. *Journal of Applied Behavior Analysis, 22,* 245–259.

Griffen, A. K., Wolery, M., & Schuster, J. W. (1992). Triadic instruction of chained food preparation responses: Acquisition and observational learning. *Journal of Applied Behavior Analysis, 25,* 193–204.

Hall, M. G., Schuster, J. W., Wolery, M., Gast, D. L., & Doyle, P. M. (1992). Teaching chained skills in a non-school setting using a divided half instructional format. *Journal of Behavioral Education, 2,* 257–279.

Hay, D. F., Murray, P., Cecire, S., & Nash, A. (1985). Social learning and social behavior in early life. *Child Development, 56,* 43–57.

Hundert, J., & Houghton, A. (1992). Promoting social interaction of children with disabilities in integrated preschools: A failure to generalize. *Exceptional Children, 58,* 311–320.

Kayser, J. E., Billingsley, F. F., & Neel, R. S. (1986). A comparison of in-context and traditional instructional approaches: Total task, single trial versus backward chaining multiple trials. *Journal of the Association for Persons with Severe Handicaps, 11,* 28–38.

Keel, M. C., & Gast, D. L. (1990). Small group instruction for students with learning disabilities: Observational and incidental learning. *Exceptional Children, 58,* 357–367.

McDonnell, J., & McFarland, S. (1988). Comparison of forward and concurrent chaining strategies in teaching laundromat skills to students with severe handicaps. *Research in Developmental Disabilities, 9,* 177–194.

Newcomer, P., & Hammill, D. D. (1988). *Test of Language Development—2.* Austin, TX: Pro-Ed.

Odom, S. L., McConnell, S. R., & McEvoy, M. E. (Eds.). (1992). *Social competence of young children with disabilities: Issues and strategies for intervention.* Baltimore: Paul H. Brookes.

Putnam, J. W. (1993). The movement toward teaching and learning in inclusive classrooms. In J. W. Putnam (Ed.), *Cooperative learning and strategies for inclusion: Celebrating diversity in the classroom* (pp. 1–14). Baltimore: Paul H. Brookes.

Schoen, S. F., Lentz, F. E., & Suppa, R. J. (1988). An examination of two prompt fading procedures and opportunities to observe in teaching handicapped preschoolers self-help skills. *Journal of the Division of Early Childhood, 12,* 349–358.

Schoen, S. F., & Sivil, E. O. (1989). A comparison of procedures in teaching self-help skills: Increasing assistance, time delay, and observational learning. *Journal of Autism and Developmental Disorders, 19,* 57–72.

Stainback, S., & Stainback, W. (1992). *Curriculum considerations in inclusive classrooms: Facilitating learning for all students.* Baltimore: Paul H. Brookes.

Terman, L., & Merrill, M. (1973). *Stanford-Binet Intelligence Scale.* Boston: Houghton Mifflin.

Thomas, J. H., Due, L. M., & Wigger, D. N. (1987). Effects of the competence and sex of peer models on children's imitative behavior. *Journal of Genetic Psychology, 148,* 325–332.

Thorndike, R., Hagen, E., & Sattler, J. (1986). *Stanford-Binet Intelligence Scale.* Chicago: Riverside Publishing Company.

Wolery, M., Ault, M. J., Gast, D. L., Doyle, P. M.,

& Griffen, A. K. (1990). Comparison of constant time delay and the system of least prompts in teaching chained tasks. *Education and Training in Mental Retardation, 25,* 243–257.

Wolery, M., Ault, M. J., Gast, D. L., Doyle, P. M., & Griffen, A. K. (1991). Teaching chained tasks in dyads: Acquisition of target and observational behaviors. *Journal of Special Education, 25,* 198–220.

Wolery, M., Cybriwsky, C. A., Gast, D. L., & Boyle-Gast, K. (1991). Use of constant time delay and attentional responses with adolescents. *Exceptional Children, 57,* 462–474.

Wright, C. W., & Schuster, J. W. (1994). Accepting specific versus functional student responses when training chained tasks. *Education and Training in Mental Retardation and Developmental Disabilities, 29,* 43–56.

Zimmerman, I. L., Steiner, V. G., & Evatt, R. L. (1969). *Preschool Language Scale.* Columbus, OH: Merrill.

Received October 31, 1994
Initial editorial decision December 31, 1994
Revision received March 13, 1995
Final acceptance October 11, 1995
Action Editor, Anthony Cuvo